

12

**EUROPEAN PATENT APPLICATION**

21 Application number: 88309679.4

51 Int. Cl.<sup>4</sup>: **F 41 H 5/04**  
**B 32 B 18/00**

22 Date of filing: 14.10.88

30 Priority: 16.10.87 IT 2230187

43 Date of publication of application:  
19.04.89 Bulletin 89/16

84 Designated Contracting States:  
AT BE DE ES FR GB GR NL SE

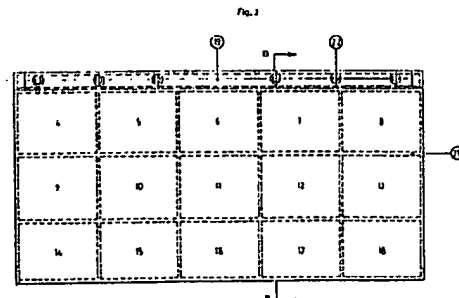
71 Applicant: **LASAR S.P.A.**  
**31, Foro Buonaparte**  
**Milan (IT)**

72 Inventor: **Cappa, Arnaldo Carlo**  
**15, via Lucinasco**  
**I-22100 Montano Lucino (CO) (IT)**

74 Representative: **Whalley, Kevin et al**  
**MARKS & CLERK 57/60 Lincoln's Inn Fields**  
**London WC2A 3LS (GB)**

54 Semi-rigid stratified shield.

57 A semi-rigid stratified shield, consisting of at least one layer of a ceramic and/or sintered material, which may be in the form of a mosaic of adjacent plates (2) (coupled to a carrier), embedded in an elastomeric matrix (20), said shield being pivotable at one side.



## Description

## SEMI-RIGID STRATIFIED SHIELD

This invention relates to a semi-rigid stratified shield, having improved impact-resistance and/or penetration resistance as well as inhibiting properties against thermal radiation.

More particularly, the invention is concerned with the realization of a flexible, stratified semi-rigid shield suitable for providing protection to the bodies of vehicles, to the hulls of aircraft and to generic structures or to critical parts thereof, either integrative or permanent, in various protective systems.

The shield according to the invention can be used, in particular, in the field of the so-called modern systems, for the protection of motor vehicles such as cars, delivery vans, logistical vehicles, mobile shelters and so on, or as fenders and as means for the protection against raising of dust and so on, because of its lightness and flexibility.

Such a shield leads to particularly good results, for instance low overall weight per single unit, flexibility and mobility, compared to the characteristics of the conventional equivalent protective shieldings.

There are known protective stratified materials, specifically materials structured as a laminate of plastic materials combined with fabrics (of glass, artificial fibres and so on). Nonetheless, in such material there often occur delamination phenomena, during their use, which considerably reduce their efficiency; in other words they prove to be not suitable, for instance, in the case of a low elastomeric module matrix, in those applications where a certain rigidity, a certain surface hardness and chemical and/or thermal resistance are required.

The present invention aims to provide a semi-rigid stratified shield, having improved impact and/or penetration resistance, which may overcome or at least mitigate the drawbacks of the prior art.

More particularly, the invention aims to provide a semi-rigid stratified shield suitable for protective systems for persons and/or critical mechanical operational parts in hulls (bodies) of mobile means, due to its adaptability to structures requiring maximum protective efficiency, consistent with a reduction of the overall weight of the same.

The present invention provides a semi-rigid stratified shield, swinging on one of its sides, comprising at least one layer of a ceramic and/or sintered material coupled to a mechanical support, embedded in an elastomeric matrix.

Thus there may be formed a semi-rigid stratified structure, with strong bonds between the different layers, combined with certain compliance in the direction normal to the layers. A stratified structure of this kind allows a proper distribution of the impact energy dispersing the same energy over a surface far wider than the impact surface itself; the absorption of the impact energy increases with the total surface of the successive layers, the bonds of which are perturbed, a consequential directional destabilization being exerted on the impacting body.

The stratified shield is preferably kept at a certain distance from the structure to be protected, said

distance being proportional to the size of the impacting body, for instance at least twice its length.

In other words, in the semi-rigid stratified shield of the invention, there occur a sum of actions summarized as follows:

- reactivity of the structure to the impact, which develops a succession of elastic response waves, with a speed up to 4000-6000 m/s:

- conical distribution of the impact energy, dispersing the load on its structure and composition; the shield can even minimize the thermal radiation coming from the inside of the protected structure.

The layer or layers of ceramic and/or sintered material may also be constituted, in their turn, by a plurality of plates arranged as a mosaic and contained in a tray-like frame, made of a metal or its alloy, such as for instance aluminium, its alloys, different kinds of steel and so on, or of plastic materials such as polyethylene, polypropylene, polyvinylchloride and so on.

The tray, acting as an assembly frame for said plates, may moreover have a form and size as required by the type of the foreseen structure and location, taking into consideration the adaptability to the structure of the vehicle.

For illustration purposes, the new shield may be technically obtained in a substantially polygonal, preferably quadrangular, shape.

The layer of ceramic and/or sintered material is preferably formed by one or more plates of a ceramic material, based on oxides, or on sintered materials based on metal oxides and/or metals.

As far as the carrier is concerned, this latter is made of a material having the function of strengthening the plate or the mosaic of ceramic plates at the moment of the impact or in the case of breaking.

The carrier may thus consist of any material suited for a mechanical action, developing a high resistance to the above mentioned stresses, such as for example metals or their alloys, composite materials etc.

A suitable material, based on alternate layers of a fabric and of an elastomeric or plastomeric material, is described in European patent No. 49014.

The layers forming the shield may be coupled to each other by means of conventional adhesives (glues) interposed (spread) between the tray and the ceramic plate and between this latter and the carrier.

The ceramic layer or layers mentioned hereinabove may be embedded into an elastomeric matrix (natural rubber, synthetic rubbers etc.), according to the techniques of the prior art, and have a size and shape suitable for the desired shielding.

In order to obtain a better assembly of the shield's structural components, it is possible to embed structural reinforcing elements constituted by a metal net or by a synthetic material, films, polyester, acrylic or poly-olefinic nets, fibrilled films etc.

The thus obtained shield may be fitted with a suitable rigid suspension bar (of metal etc.) around

which the shield itself may pivot, keeping the shield spaced apart from the structure to be protected at a distance which is preferably at least twice the length of the impacting body.

The shielding achieved by means of the shield of the invention, other performance factors being equal, allows weight savings of the order of 40-60% to be achieved, with respect to conventional metal protections or, at equal weight, it is possible to increase the protective power or capacity and, this latter factor remaining equal, it is possible to keep the weight on macroscopically reduced levels, with considerable advantages for the operational capacity of the protected mobile means.

The simplest manner for the installation of the shield of the invention is to fix the corresponding rigid suspension bar to the hull or to the structure of the mobile means by using bolts. There are, however, other possible systems such as for instance hinges etc, according to the techniques of the prior art.

The invention will be further described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 is a plan view of a shield according to the invention, showing the carrier partly cut away;

Fig. 2 is a cross-sectional view taken along line A-A in fig. 1;

Fig. 3 is a plan view of a carrier, with a plurality of layers according to fig. 1; and

Fig. 4 is a cross-sectional view of the shield taken along the line B-B in fig. 3.

More specifically, Figs. 1 and 2 show an embedded layer consisting of a holding tray 1 containing 12 ceramic plates 2, whose shape is indicated by broken lines, and on which is superimposed a carrier 3, indicated in the drawing by the portion marked by diagonal lines (indicating the surface of structural layer).

Figs. 3 and 4 show, as a practical form of embodiment of the invention, a complete shield, wherein reference numerals 4 to 18 indicate as many layers as according to fig. 1, while numeral 19 indicates a metal supporting shaft with bolts 22, around which the shield is free to pivot. Numeral 20 indicates the elastomeric layer containing a metal reinforcing net 21, into which matrix are embedded the ceramic layers 7, 12 and 17 (see figure 4).

## Claims

1. A semi-rigid stratified shield, pivotable at one of its sides, characterized by comprising at least one layer of ceramic and/or sintered material, coupled to a support, embedded in an elastomeric matrix.

2. A shield as claimed in claim 1, characterized in that said layer of ceramic and/or sintered material consists of a plurality of plates (2), made of a material selected from oxide-based ceramics and sintered materials based

on metal oxides and/or metals.

3. A shield as claimed in claim 2, characterized in that said layer of ceramic and/or sintered material is contained in a tray-like frame (1) of a metal selected from aluminium and its alloys, steels and plastics materials.

4. A shield as claimed in any of claims 1 to 3, characterized in that said carrier is made of a high-resistance material, selected from metals, their alloys and composite materials.

5. A shield as claimed in any of claims 1 to 4, characterized in that said stratified material is assembled by means of an adhesive, applied between a tray-like frame (1) and said layer and between said layer and the carrier.

6. A shield as claimed in any of claims 1 to 5, characterized in that said layer or layers are embedded in an elastomeric matrix (20, 21) selected from natural and synthetic rubbers.

7. A shield as claimed in claim 6, characterized in that said elastomeric matrix also contains structural elements selected from metal nets and from nets and films of a synthetic material selected from polyesters, polyolefines and polyacrylates.

8. A shield as claimed in any of claims 1 to 7, characterized by having essentially a polygonal, preferably quadrangular, shape.

Fig. 1

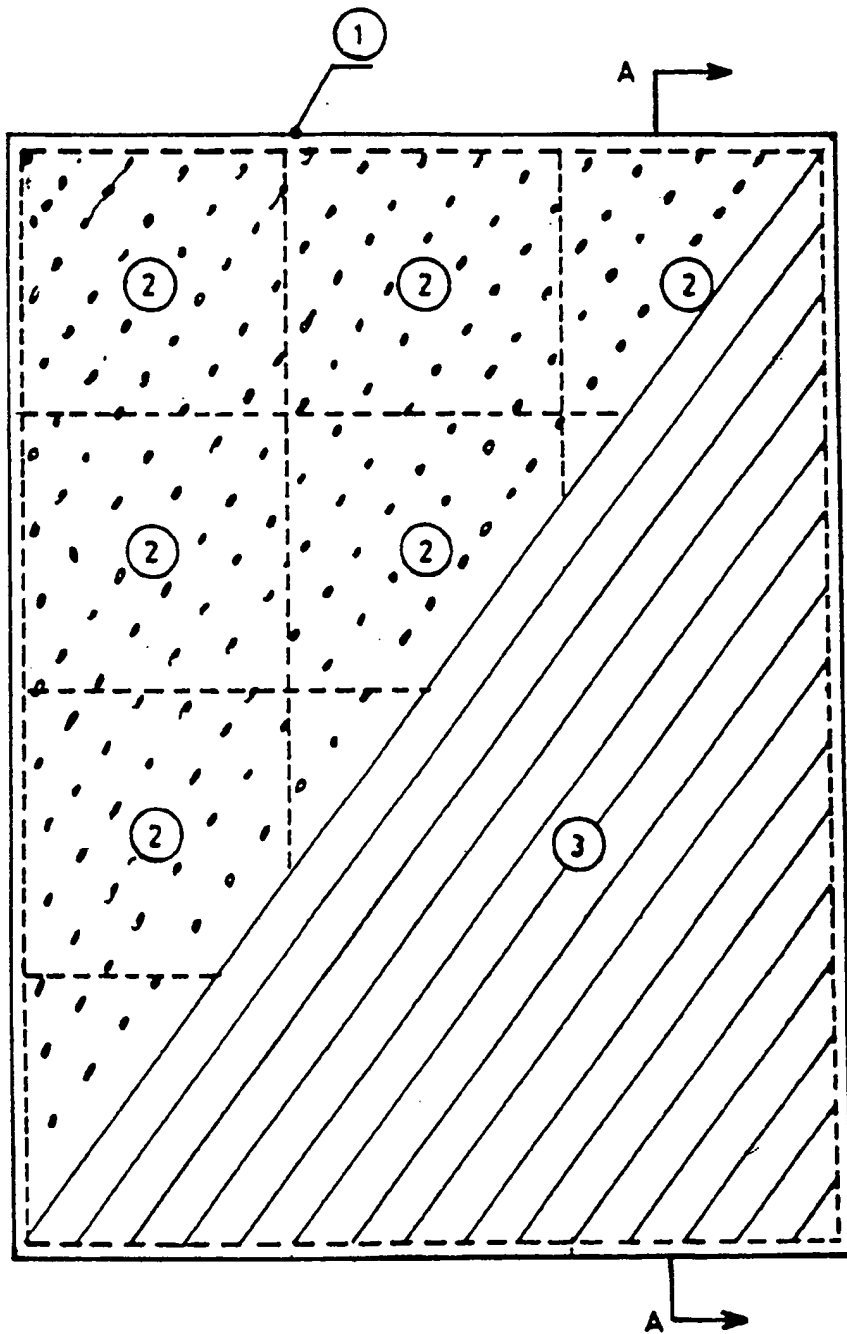


Fig. 2

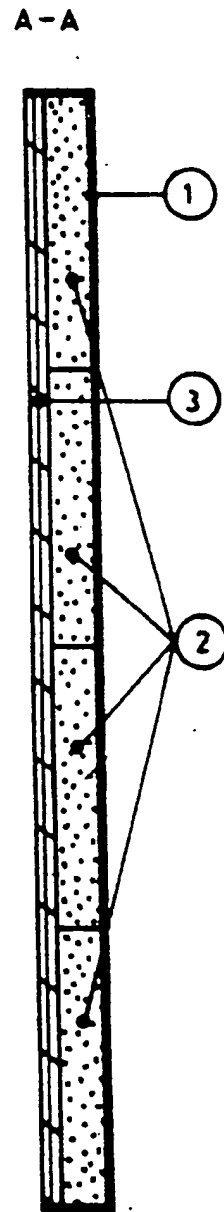


Fig. 3

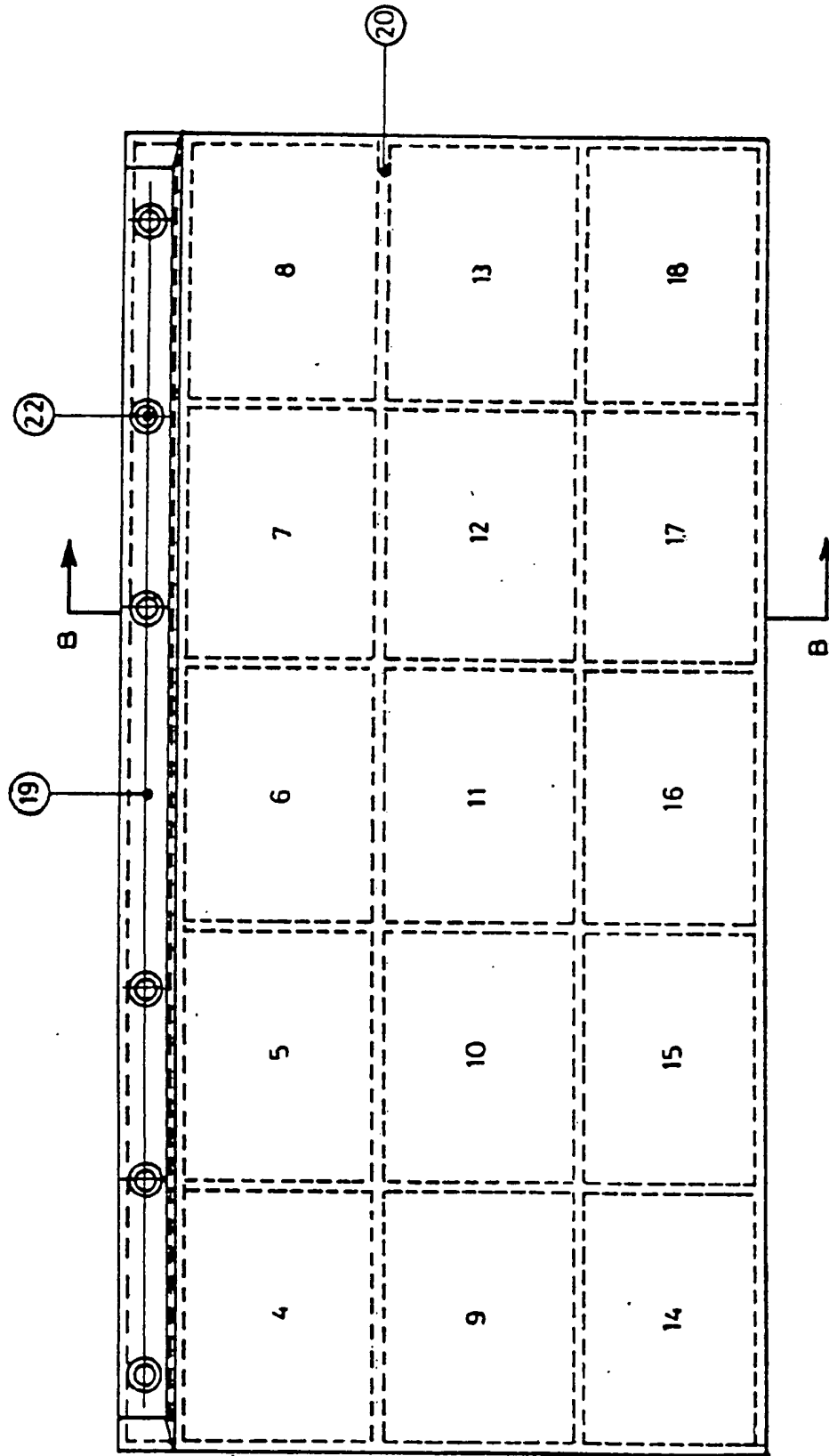
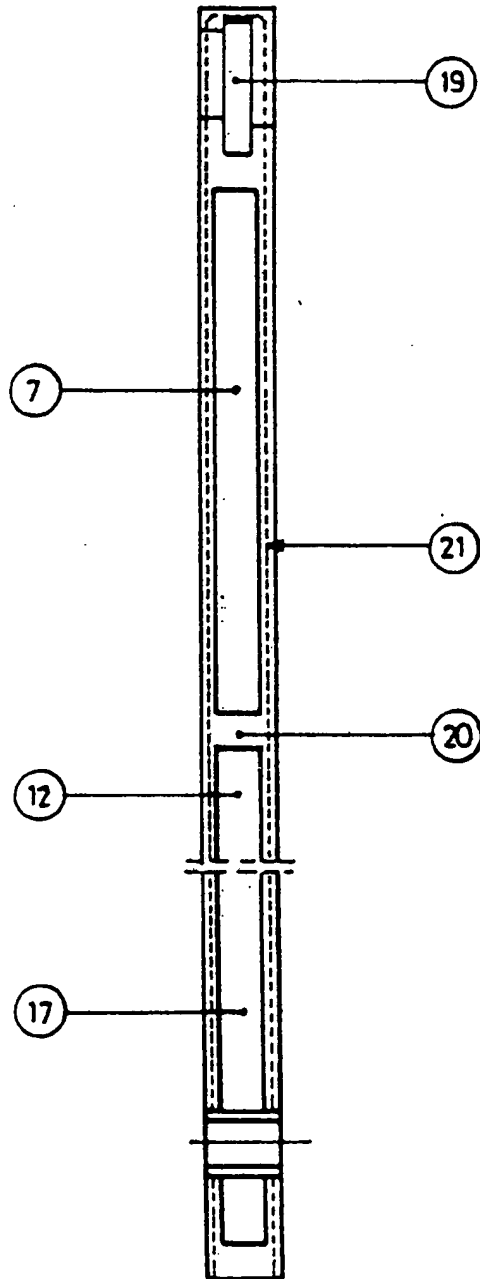


Fig. 4

B-B





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number

EP 88 30 9679

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-3 431 818 (KING) * Column 2, lines 36-72; column 3, lines 1-75; column 4, lines 14-65; column 5, lines 69-75; column 6, lines 1-34; figures 1-5C *	1-8	F 41 H 5/04 B 32 B 18/00
X	EP-A-0 041 271 (GORUM) * Page 5, lines 8-28; page 6, lines 14-28; page 7, line 31; page 8, as a whole; page 10, lines 4-31; page 11, lines 1-27; figures 1-10 *	1-8	
X	US-A-4 030 427 (GOLDSTEIN) * Column 1, lines 8-17; column 2, lines 28-49,68-69; column 3, lines 1-7,31-55; figure unique *	1-8	
X	US-A-3 516 898 (COOK) * Column 2, lines 36-72; column 3, lines 1-73; column 4, lines 1-11; figures 1-10 *	1-8	
X	DE-A-1 952 759 (BALLU) * Page 2, paragraphs 4,5; page 3, paragraphs 1-4; figures 1-5 *	1-6,8	TECHNICAL FIELDS SEARCHED (Int. Cl.4) F 41 H B 32 B
A	US-A-4 061 815 (POOLE) * Column 4, lines 61-68; column 5, lines 4-15; figure 3 *	7	
P,A	EP-A-0 241 641 (GILLES) * Column 1, lines 35-43; figure 1 *	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12-12-1988	Examiner VAN DER PLAS J.M.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 150 (12.82) (P0601)